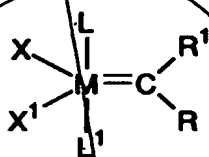


CLAIMS

What is claimed is:

1. A compound of the formula



wherein:

M is selected from the group consisting of Os and Ru;

R¹ is hydrogen;

R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X' are independently selected from any anionic ligand; and

L and L¹ are independently selected from any neutral electron donor.

2. A compound according to claim 1, wherein the substituted alkyl includes one or more functional groups selected from the group consisting of aryl, alcohol, thiol, ketone, aldehyde,

ester, ether, amine, imine, amide, nitro, carboxylic acid,
disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy,
and halogen.

5 3. A compound according to claim 1, wherein the substituted
aryl includes one or more functional groups selected from the
group consisting of alkyl, aryl, alcohol, thiol, ketone,
aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic
10 acid, disulfide, carbonate, isocyanate, carbodiimide,
carboalkoxy, and halogen.

4. A compound according to claim 1 wherein R is selected
from the group consisting of
15 (a) hydrogen;
(b) C₁-C₂₀ alkyl;
(c) aryl;
(d) C₁-C₂₀ alkyl substituted with one or more groups
selected from the group consisting of aryl, halide,
hydroxy, C₁-C₂₀ alkoxy, and C₂-C₂₀ alkoxy carbonyl; and
20 (e) aryl substituted with one or more groups selected
from the group consisting of C₁-C₂₀ alkyl, aryl, hydroxyl,
C₁-C₅ alkoxy, amino, nitro, and halide.

5. A compound according to claim 4, wherein R is phenyl or phenyl substituted with a group selected from the group consisting of chloride, bromide, iodide, fluoride, $-\text{NO}_2$, $-\text{NMe}_2$, methoxy, and methyl.
6. A compound according to claim 5, wherein R is phenyl.
7. A compound according to claim 4, wherein R is selected from the group consisting of hydrogen, methyl, ethyl, n-butyl, iso-propyl, $-\text{CH}_2\text{Cl}$, $-\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$, and $-\text{CH}_2\text{OAc}$.
8. A compound according to claim 1 wherein L and L^1 are independently selected from the group consisting of phosphine, sulfonated phosphine, phosphite, phosphinite, phosphonite, arsine, stibine, ether, amine, amide, sulfoxide, carboxyl, nitrosyl, pyridine, and thioether.
9. A compound according to claim 8, wherein L and L^1 are phosphines independently selected from $\text{PR}^3\text{R}^4\text{R}^5$ wherein R^3 is selected from the group consisting of secondary alkyl and cycloalkyl and wherein R^4 and R^5 are independently selected

from the group consisting of aryl, C₁-C₁₀ primary alkyl, secondary alkyl, and cycloalkyl.

10. A compound according to claim 9, wherein L and L¹ are independently selected from the group consisting of -P(cyclohexyl)₃, -P(cyclopentyl)₃, and -P(isopropyl)₃.

11. A compound according to claim 8, wherein L and L¹ are both -P(phenyl)₃.

12. A compound according to claim 8, wherein L and L¹ are the same.

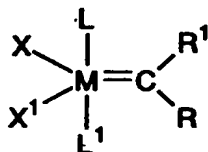
13. A compound according to claim 1, wherein X and X¹ are independently selected from the group consisting of halogen, hydrogen; C₁-C₂₀ alkyl, aryl, C₁-C₂₀ alkoxide, aryloxy, C₃-C₂₀ alkyldiketonate, aryldiketonate, C₁-C₂₀ carboxylate, aryl or C₁-C₂₀ alkylsulfonate, C₁-C₂₀ alkylthio, C₁-C₂₀ alkylsulfonyl, or C₁-C₂₀ alkylsulfinyl; each optionally substituted with C₁-C₅ alkyl, halogen, C₁-C₅ alkoxy or with a phenyl group optionally substituted with halogen, C₁-C₅ alkyl or C₁-C₅ alkoxy;

14. A compound according to claim 13, wherein X and X¹ are independently selected from Cl, Br, I, H; benzoate, C₁-C₅ carboxylate, C₁-C₅ alkyl, phenoxy, C₁-C₅ alkoxy, C₁-C₅ alkylthio, aryl, or C₁-C₅ alkyl sulfonate; each optionally substituted with C₁-C₅ alkyl or a phenyl group optionally substituted with halogen, C₁-C₅ alkyl or C₁-C₅ alkoxy.

15. A compound according to claim 14, wherein X and X¹ are independently selected from the group consisting of Cl, CF₃CO₂, CH₃CO₂, CFH₂CO₂, (CH₃)₃CO, (CF₃)₂(CH₃)CO, (CF₃)(CH₃)₂CO, PhO, MeO, EtO, tosylate, mesylate, and trifluoromethanesulfonate.

16. A compound according to claim 15, wherein X and X¹ are both Cl.

17. A compound of the formula



wherein:

M is selected from the group consisting of Os and Ru;

R¹ is hydrogen;

R is a group selected from the group consisting of

(a) hydrogen;

(b) C₁-C₄ alkyl;

(c) phenyl;

(d) C₁-C₄ alkyl substituted with one or more groups selected from the group consisting of halide, hydroxy, and C₂-C₅ alkoxy carbonyl; and

(e) phenyl substituted with one or more groups selected from the group consisting of C₁-C₅ alkyl, C₁-C₅ alkoxy, amino, nitro, and halide;

X and X¹ are independently selected from any anionic ligand; and

L and L¹ are independently phosphines of the formula PR³R⁴R⁵ wherein R³ is selected from the group consisting of secondary alkyl and cycloalkyl and wherein R⁴ and R⁵ are independently selected from aryl, C₁-C₁₀ primary alkyl, secondary alkyl and cycloalkyl.

18. A compound according to claim 17, wherein the substituted phenyl is para-substituted.

19. A compound according to claim 18, wherein R is phenyl or phenyl substituted with a group selected from the group consisting of chloride, bromide, iodide, fluoride, $-\text{NO}_2$, $-\text{NMe}_2$, methoxy, and methyl.

5

20. A compound according to claim 19, wherein R is phenyl.

21. A compound according to claim 17, wherein R is selected from the group consisting of hydrogen, methyl, ethyl, n-butyl, iso-propyl, $-\text{CH}_2\text{Cl}$, $-\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$, and $-\text{CH}_2\text{OAc}$.

10

22. A compound according to claim 17, wherein L and L^1 are independantly selected from the group consisting of - $\text{P}(\text{cyclohexyl})_3$, $-\text{P}(\text{cyclopentyl})_3$, and $-\text{P}(\text{isopropyl})_3$.

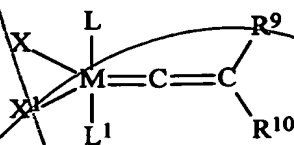
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23. A compound according to claim 17, wherein X and X^1 are both Cl.

24. A compound according to claim 17, wherein R is phenyl, M is Ru, X and X^1 are both Cl, and L and L^1 are the same and are selected from the group consisting of $-\text{P}(\text{cyclohexyl})_3$, $-\text{P}(\text{cyclopentyl})_3$, and $-\text{P}(\text{isopropyl})_3$.

20

25. A compound of the formula



wherein:

M is selected from the group consisting of Os and Ru;

R⁹ and R¹⁰ are independently selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X¹ are independently selected from any anionic ligand; and

L and L¹ are independently selected from any neutral electron donor.

26. A compound according to claim 25, wherein the substituted alkyl includes one or more functional groups selected from the group consisting of aryl, alcohol, thiol, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, and halogen.

27. A compound according to claim 25, wherein the substituted aryl includes one or more functional groups selected from the group consisting of alkyl, aryl, alcohol, thiol, ketone, aldehyde, ester, ether, amine, imine, amide, nitro, carboxylic acid, disulfide, carbonate, isocyanate, carbodiimide, carboalkoxy, and halogen.

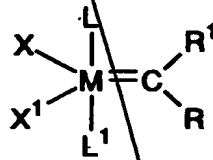
28. A compound according to claim 25, wherein R^9 and R^{10} are independently selected from the group consisting of

- (a) hydrogen;
- (b) C_1 - C_{20} alkyl;
- (c) aryl;
- (d) C_1 - C_{20} alkyl substituted with a group selected from the group consisting of halide, aryl, alkoxy, and aryloxy;
- and
- (e) aryl substituted with a group selected from the group consisting of halide, alkyl, aryl, alkoxy, and aryloxy.

29. A compound according to claim 25, wherein M is Ru, R^9 and R^{10} are hydrogen, X and X^1 are Cl, and L and L^1 are the same and are selected from the group consisting of -

P(cyclohexyl)₃, -P(cyclopentyl)₃, -P(isopropyl)₃, and -
P(phenyl)₃.

5 30. A process for polymerizing cyclic olefins comprising the
step of contacting a cyclic olefin with a compound of the
formula



10 wherein:

M is selected from the group consisting of Os and Ru;

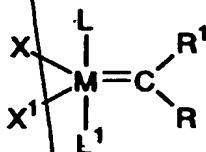
R¹ is hydrogen;

15 R is selected from the group consisting of hydrogen,
substituted or unsubstituted alkyl, and substituted or
unsubstituted aryl;

X and X¹ are independently selected from any anionic
ligand; and

20 L and L¹ are independently selected from any neutral
electron donor.

31. A process for depolymerizing an unsaturated polymer comprising contacting an unsaturated polymer with a compound of the formula



in the presence of an acyclic olefin, wherein:

M is selected from the group consisting of Os and Ru;

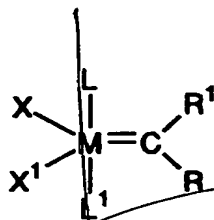
R¹ is hydrogen;

R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X' are independently selected from any anionic ligand; and

L and L' are independently selected from any neutral electron donor.

32. A process for synthesizing a cyclic olefin comprising the step of contacting a diene with a compound of the formula



wherein:

5 M is selected from the group consisting of Os and Ru;

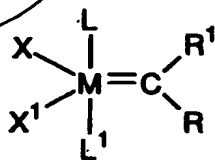
R¹ is hydrogen;

R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

10 X and X' are independently selected from any anionic ligand; and

L and L' are independently selected from any neutral electron donor.

15 33. A process for synthesizing an unsaturated polymer comprising the step of contacting a diene with a compound of the formula



20

wherein:

M is selected from the group consisting of Os and Ru;

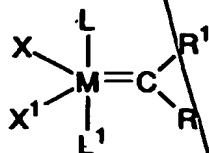
R¹ is hydrogen;

R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X¹ are independently selected from any anionic ligand; and

L and L¹ are independently selected from any neutral electron donor.

34. A process for synthesizing telechelic polymers by metathesis polymerization comprising contacting a cyclic olefin with a compound of the formula



in the presence of an α,ω -difunctional olefin, wherein:

M is selected from the group consisting of Os and Ru;

R¹ is hydrogen;

R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

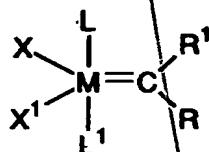
X and X¹ are independently selected from any anionic ligand; and

L and L¹ are independently selected from any neutral electron donor.

5

35. A process for synthesizing olefins by metathesis comprising contacting an acyclic olefin with a compound of the formula

10



wherein:

M is selected from the group consisting of Os and Ru;

R¹ is hydrogen;

15

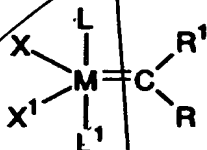
R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X¹ are independently selected from any anionic ligand; and

20

L and L¹ are independently selected from any neutral electron donor.

36. A process for synthesizing olefins by cross metathesis comprising contacting a first acyclic olefin with a compound of the formula



in the presence of a second acyclic olefin

wherein:

M is selected from the group consisting of Os and Ru;

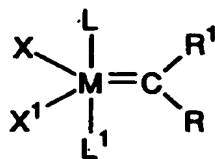
R¹ is hydrogen;

R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X¹ are independently selected from any anionic ligand; and

L and L¹ are independently selected from any neutral electron donor.

~~37~~. A process for synthesizing a compound of the formula



comprising the step of contacting a compound of the formula $(\text{XX}'\text{ML}_n\text{L}'_m)_p$ with a diazo compound of the formula $\text{RC}(\text{N}_2)\text{R}^1$, wherein:

M is selected from the group consisting of Os and Ru;

R and R^1 are independently selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

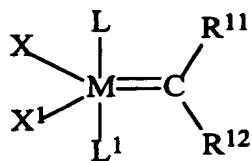
X and X' are independently selected from any anionic ligand;

L and L' are independently selected from any neutral electron donor;

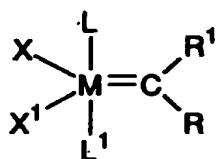
n and m are independently 0-3, provided $n + m = 3$; and p is an integer greater than 0.

38. A process according to claim 36, wherein R^1 is hydrogen.

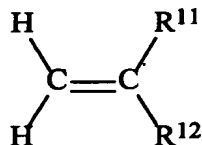
³
39. A process for synthesizing a compound of the formula



comprising the step of contacting a compound of the formula



with an olefin of the formula



wherein:

M is selected from the group consisting of Os and Ru;

R¹ is hydrogen;

R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

R¹¹ and R¹² are independently selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

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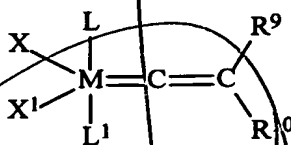
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X and X¹ are independently selected from any anionic ligand; and

L and L¹ are independently selected from any neutral electron donor].

5

40. A process for synthesizing a compound of the formula



10

comprising the step of contacting a compound of the formula (XX¹ML_nL¹_m)_p with an acetylene of the formula R⁹CCR¹⁰, wherein:

15

M is selected from the group consisting of Os and Ru;
R⁹ and R¹⁰ are independently selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

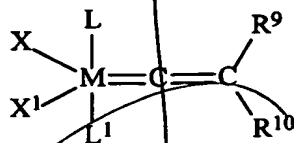
X and X¹ are independently selected from any anionic ligand; and

20

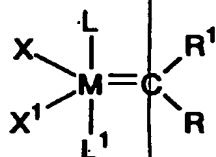
L and L¹ are independently selected from any neutral electron donor;

n and m are independently 0-3, provided n + m = 3; and
p is an integer greater than 0.

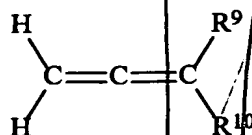
41. A process for synthesizing a compound of the formula



comprising the step of contacting a compound of the formula



with a cumulated olefin of the formula



wherein:

M is selected from the group consisting of Os and Ru;

R¹ is hydrogen;

R is selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

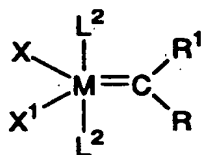
R⁹ and R¹⁰ are independently selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X¹ are independently selected from any anionic ligand; and

L and L¹ are independently selected from any neutral electron donor.

5

42. A process for synthesizing a compound of the formula



10

comprising the step of contacting a compound of the formula (XX¹ML_nL¹_m)_p with a diazo compound of the formula RC(N₂)R¹ in the presence of a neutral electron donor of the formula L², wherein:

M is selected from the group consisting of Os and Ru;

15

R and R¹ are independently selected from the group consisting of hydrogen, substituted or unsubstituted alkyl, and substituted or unsubstituted aryl;

X and X¹ are independently selected from any anionic ligand;

20

L, L¹, and L² are independently selected from any neutral electron donor;

n and m are independently 0-3, provided n + m = 3; and

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p is an integer greater than 0.